

## THE USE OF AIRPOWER ON HUMANITARIAN OPERATIONS: A CASE STUDY IN BRAZIL

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### ABSTRACT

**Goal:** The main purpose of this research is to present the benefits reached with the use of airpower resources during humanitarian operations, in order to verify how the main airpower's characteristics influenced the response stage of a natural disaster in Brazil.

**Design / Methodology / Approach:** A qualitative case study was conducted to evaluate benefits reached with the use of airpower during humanitarian operations. Primary and secondary data were gathered from operational reports provided by the Brazilian Air Force, from media coverage about the flood and waterlogging events happened in November 2008, in Itajai Valley, Santa Catarina State, Brazil. Interviews with three informants involved in crisis response were also conducted. Data analysis processes were conducted to search codes about airpower engagement during humanitarian operations. Data coding followed an inductive approach and the codes emerged from data.

**Results:** The research concludes that the use of airpower can leverage crisis response capabilities during humanitarian operations, as airpower's characteristics of speed, mobility, flexibility, penetration, range, and readiness meet the needs of humanitarian operations to respond to a natural disaster. The case study demonstrates an increase of operational capabilities after airpower engagement.

**Limitations of the investigation:** Only one crisis situation was studied, because the access to operational data provided by the Brazilian Air Force is restricted. Besides, it was not possible to analyze values and budgetary costs derived from airpower engagement.

**Practical implications:** The results of this research demonstrate that it is highly important to involve airpower during humanitarian operations, as it can leverage crisis response capabilities. In this way, humanitarian organizations can establish new forms of relationship to national and local governments in order to quickly engage airpower resources on the response phase of natural disasters.

**Originality/Value:** This research presents an original contribution to the field of humanitarian operations as it presents real data in terms of the engagement of airpower resources during humanitarian operations.

**Keywords:** Airpower; Humanitarian Operations; Crisis Management.

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## 1. INTRODUCTION

Crises come in many shapes and forms. They are low-probability and high-impact events that threaten the viability of societies and organizations and are characterized by ambiguity of cause, effect and means of resolution (Pearson and Clair, 1998). In fact, crises arise as the result of multiple events, which interact over time to produce a threat with devastating potential (Roux-Dufort, 2009).

According to the United Nations Office for Disaster Risk Reduction (UNDRR), formerly known as UNISDR, disasters, in turn, are characterized by threats that extrapolate the risk limit and happen in a vulnerable environment (UNISDR, 2015). Disasters can also be defined as the result of adverse events on a vulnerable scenario, causing serious disturbance on the normal equilibrium of a location, which can cause severe loss and human, material or environmental damage that can surpass local capabilities to stop or mitigate its effects.

As human conflicts, man-made accidents, economic problems or natural events shatter the ordinary order of societies. All of these events could be defined as crises, including situations characterized as disasters. Fink (1986) affirms that a crisis is an unstable time or state of affairs in which a decisive change is impending, either one with the distinct possibility of a highly undesirable outcome, or one that can finish with an extremely positive result.

Nevertheless, the negative connotation of the word crisis often prevails. When a crisis occurs, people automatically think that it arrives as a barrage of urgent, unexpected and unpleasant events, allowing little time to organize or plan appropriate responses, and making people and organizations to operate at their extreme. In this context, crisis management is essential to breach or bridge crisis response efforts and create a happy end (Silveira dos Santos, 2020).

According to Pearson and Clair (1998), organizational crisis management is a systematic attempt by organizational members with external stakeholders to avert crises or to effectively manage those that do occur. In this way, crisis management will always involve different organizations, with distinct perspective, capabilities and action patterns. Of course, the bigger is the crisis episode, the higher is the number of organizations involved in crisis response. Then, it is very difficult to coordinate activities and organize workflows between them.

In this way, stakeholders' coordination has become an important research area in crisis management literature and other related areas of study, such as humanitarian logistics. According to Bertazzo et al. (2017), when a disaster occurs, the local government and different entities within or abroad the involved country are mobilized to help victims, in order

to provide search and rescue activities, distribute relief supplies, medicines, water and basic survival items, allocate people in shelters, and carry out many other activities that aim to minimize victims' suffering.

In such context, the effective detection of real needs referred to relief supplies to the victims becomes a difficult factor because of the unpredictability of the disaster event, mainly related to time, location, type, and size of the crisis (Beamon and Kotleba, 2006). Then, it is important to mobilize all capabilities that are available to engage on crisis response activities, as soon as possible, mainly because the amount of time needed to mitigate crisis' hazards can reflect life savings and can mitigate or even avoid other constraints. In other words, if crisis response capabilities take too long to be in place, the number of life losses and other human, material or environmental damages can significantly increase.

With the aim to act rapidly, save lives and provide relief assistance to victims and other involved people, it is important to mobilize all possible capabilities, mainly those that can make a great difference. In these circumstances, the use of airspace can leverage humanitarian logistics, because it allows executing a great variety of activities on a faster period of time, such as location mapping and damage evaluation, victim rescue, quick transportation, emergency relief equipment delivery, donation transportation, and many others services. However, the use of airspace is not that easy because it is needed a complex infrastructure and advanced technological assets. Besides, the use of airspace is expensive and restricted to meteorological conditions. That is the reason why the use of airpower is normally controlled by governments.

Airpower definitions have developed progressively over the past decades and normally involve the ability of a nation to carry cargo and people, and the military's ability to assert its will through airborne. In this way, the control and use of airspace is a national security question and most capabilities involving airpower are delegated to a nation's armed forces. Then, airpower can be used to attack or to defend. In this paper, emphasis will be given to the use of airspace for peaceful intents, mainly for humanitarian logistics.

Brazil is a country with a history of natural and anthropogenic disasters, such as the flood and waterlogging events in Blumenau and the Itajai Valley (2008) and in Rio de Janeiro's Mountain Region (2011). In such events, managing the donations and coordinating the supply chain logistics are essential activities for the success of humanitarian operations. In this context, the use of airspace can make a great difference.

The motivation to conduct the present study reflects the absence of published research with a look upon the use of

airpower to leverage crisis management and humanitarian operations. This paper, then, aims to present the benefits reached with the use of airpower resources during humanitarian operations, in order to verify, on a real case scenario, how airpower characteristics influenced the response stage of crisis management during a natural disaster in Brazil. For doing so, a qualitative case study was conducted to collect and analyze data about the engagement of airpower during a real crisis. Primary and secondary data were gathered from operational reports, provided by the Brazilian Air Force, and from media coverage about the flood and waterlogging events in November 2008, in the Itajai Valley, Santa Catarina State, in the south of Brazil. Three interviews with people involved in the crisis' response were also conducted.

The paper is structured in five major sections. Firstly, the main theoretical background about crisis management, humanitarian operations and airpower are presented. After that, the methodological assumptions that guided the author is shown. Then, the main findings are presented, followed by a discussion between the theory and the research findings. At the end, final considerations are taken into account to drive future studies.

## 2. THEORETICAL BACKGROUND

Any crisis that affects one or more social structures, such as organizations or communities, can be called organizational crisis. For Pearson and Clair (1998), an organizational crisis is a low-probability, high-impact event that threatens the viability of the organization or community and is characterized by ambiguity of cause, effect and means of resolution, as well as by a belief that decisions must be made swiftly. This is a wide-ranging definition that covers some common elements that are present in different kinds of organizational crisis, such as breakdown of key equipment, major plant disruption, product tampering, decline in major earnings, hostage taking, terrorism, natural disasters or other kinds of organizational crises.

### Organizational Crises

Previous research has proved that organizational crises: (1) are highly ambiguous situations where causes and effects are unknown (Boin et al., 2005; Quarantelli, 1988), creating a sensemaking process that is carried out while the crisis unfolds (Boin et al., 2005; Weick, 1988); (2) have a low probability of occurring, although they pose a major threat to the survival of an organization (Watkins and Bazerman, 2004; Shrivastava et al., 1988) and to organizational stakeholders (Shrivastava, 1987); (3) offer temporal constraints, giving little time for leaders to make decisions and respond to the crises (Quarantelli, 1988; Weick and Sutcliffe, 2001); (4) disrupt

the organizational status quo (Hermann, 1963), presenting a dilemma in need of a decision that will result in change for better or worse (Fink, 1986; Sommer and Pearson, 2007); (5) change the existing relationships between leaders and followers, as the followers become more easily influenced by their leaders under the crisis stress (Halverson et al., 2004).

### *Distinct phases of a crisis*

If it is possible to draft a time continuum for a crisis, it will have, at least, three major phases: the incubation period (Turner, 1976), the critical period (Stein, 2004) and the aftermath (Garland, 1998). First of all, the incubation period, which can also be referred as the pre-crisis stage (Shrivastava, 1987) or the prodromal crisis stage (Fink, 1986), corresponds to the period of time where the organization or society is on its steady state and no danger or threats are identified. It corresponds to the organization or society ordinary state, with the normal structure and current activities running on. Fink (1986) affirms that the prodromal stage is the warning stage, when the leaders should improve the organizational abilities to identify any kind of sign that can demonstrate the escalation of a crisis. Mitroff (2004) calls these abilities as "Signal Detection" and Weick and Sutcliffe (2001) call it "Mindfulness". In this way, Fink (1986) says that it is easier to manage a crisis in the prodromal stage, because if the organization is able to identify and act on the crisis escalation signals, the leaders have the opportunity to avert the crisis. It is also important to remember that if the leaders recognize these signals but are unable to dispose of it for whatever reason, just having a sense of what is about to happen, will help the organization to prepare for the critical period.

The critical period begins with the "precipitating event" (Turner, 1976) or "triggering event" (Shrivastava, 1987; Weick, 1988) that leads to the crisis. The triggering event marks the turning point (Fink, 1986) and represents the onset of a qualitatively different period. Whereas the incubation period generally occurs over a lengthy period of months, years or even decades, the critical period is usually the much briefer time of the minutes, hours or days of the crisis itself. Fink (1986) calls this phase as the acute crisis stage and it is usually the stage in which most people think about when they speak of a crisis. If the prodromal phase alerts to the fact that a hot spot is brewing, the acute crisis phase tells that the worst has erupted. It is in this phase that the negative aspects of the crisis appears, all at once: (1) the information flows faster and intermittently (Smart and Vertinsky, 1977; Staw et al., 1981); (2) the options of communication channels reduce (Hale et al., 2005); (3) all the stakeholders become involved (Pearson and Mitroff, 1993); (4) time is limited (Quarantelli, 1988); and (5) decision making must be quick and effective (Sommer and Pearson, 2007). One of the



major difficulties in managing a crisis during this phase is the speed and intensity in which a series of constraints appear, leading the organization to the aftermath period.

Also known as the chronic crisis stage (Fink, 1986; Mitroff, 2004), the aftermath is a period of recovery, where the organization tries to respond to the constraints presented in the earlier stage. The chronic stage can linger indefinitely and it ends when the crisis is resolved. When the aftermath is over, the organization or community reaches its new ordinary state, which can be equal or different to the steady state prior to the crisis. Some authors say that the crisis cycle begins again and the organization reaches a new prodromal stage for future crises (Fink, 1986).

### Crisis Management

According to Pearson and Clair (1998), crisis management represents a systematic attempt by organizational members with external stakeholders to avert crisis or to effectively manage those that do occur. In this way, crisis management involves two main goals: (1) prevent crises from occurring; and (2) respond and contain those that have erupted. Crisis management, then, represents the organizational efforts in order to remove much of the risk and uncertainty that permeates crisis situations.

Crisis management consists of three distinct phases: crisis prevention, crisis response, and recovery from the crisis. Crisis prevention occurs in the prodromal stage of the crisis, when the organization tries to identify crisis signals and act upon them with the aim to avert the crisis occurrence. The response stage is entered when avoidance efforts fail and events trigger a crisis. At this point, organizations shift their resources and efforts to minimizing damage to the environment, the organization, and the stakeholders. Then, the recovery stage involves attempts to learn from the event and implement needed changes.

#### *Two streams of crisis management practices: anticipation versus resilience*

The crisis management literature has been developed with two main streams in order to help organizations and societies to prevent and respond to crises: the signal detection approach and the high reliability approach. The first one is based on the operational perspective of crisis research and has the assumption that the crisis affects only a part of complex organizational systems. This approach defends that it is possible to identify and isolate the crisis mechanisms, avoiding its spread to the whole organization through signal detection initiatives (Fink, 1986; Mitroff, 2004; Shrivastava, 1987). It is a vertical and centralized view of crisis manage-

ment, where the organization or community should identify possible systemic causes that could generate a crisis. Leaders should, then, concentrate on the creation of signal detection mechanisms, which, allied with contingency plans, will guide action in crisis situations (Brilman, 1985; Fink, 1986; Pearson and Mitroff, 1993).

The second approach to crisis management practices focuses on resilience, in spite of anticipation (Roe and Schulman, 2008; Shrivastava et al., 2009). It is necessary to maintain an underlying style of mental functioning that is distinguished by continuous updating and deepening of increasingly plausible interpretations of what the organizational context is, which problems define it, and what remedies it contains, in order to quickly perceive any kind of crisis, understand it and adopt the necessary responses (Roe and Schulman, 2008; Weick and Sutcliffe, 2001). This approach lies on quick learning cycles during the crisis episode or during intercrisis periods (Moynihan, 2009).

### Humanitarian Operations and Logistics

As discussed before, crisis management has three major stages, called crisis prevention, crisis response, and recovery from crisis. During crisis prevention, organizations focus on signal detection and anticipation. From the other side, crisis response focuses on major constraints and how to mitigate or annulate them. Because of that, most of activities during crisis response can have a reactive bias.

During the critical period, problems caused by the crisis are visible and can affect victims. In this context, humanitarian operations are very important to help victims and relief their suffering. Natural disaster is a specific kind of crisis, which normally involves the devastation of geographical area and populations. This kind of event is quite unpredictable and makes difficult to have appropriate crisis prevention. This is the reason why humanitarian operations are extremely relevant to respond to a natural disaster, as this kind of phenomenon has a great potential to involve people that live in the affected area (Samed and Gonçalves, 2017).

Humanitarian Logistics, then, can be defined as the set of planning and action that aims to save lives, transport people and materials, promote information flux and manage procurement, storage, transport, and supplies distribution to help people affected by disasters or complex situations (Samed and Gonçalves, 2017).

Humanitarian Logistics cover a wide range of activities that occur at any phase of emergency management, i.e. mitigation, preparedness, response, and recovery. Mitigation and preparedness activities are performed before the disaster to enhance safety and reduce the potential impact

on people and infrastructure, as for example, practice drills related to relief distribution, pre-positioning of critical supplies, and building codes. Response-related Humanitarian Logistics activities include the transportation of supplies and equipment for search and rescue, and of equipment and material for emergency repairs to the infrastructure (Holguín-veras et al., 2012).

A variety of disaster characteristics impact emergency preparedness and response activities, such as (1) the speed of onset, which can be sudden, as in the case of a tsunami, or gradual as a famine; (2) the time between the identification of the disaster agent and the onset of its effects in a particular place (length of forewarning); (3) the severity of social disruption and physical harm (magnitude of impact); (4) the size (boundaries) and nature of the impacted area or social disruption (scope of impact), as for example, debris after an earthquake or flood water after torrential rain; and (5) the length of time from the initial impact/disruption to when its effects cease (temporal duration of impact). Other characteristics can influence the nature and character of the Humanitarian Logistics response, such as the frequency or temporal regularity of disasters, the persistence of the threat (e.g., a natural disaster such as a hurricane, or a man-made conflict leading to large numbers of displaced individuals in refugee camps), and whether or not it is of catastrophic proportions (Holguín-veras et al., 2012).

Because of the disaster characteristics described above, it is very important to develop resilience during crisis response to a natural disaster. It is also very important to develop agile learning cycles to understand crisis constraints and respond to them. The response speed will be vital to save a higher number of lives or to reduce crisis impacts on the affected population. In order to meet this need for speed, it is highly recommended to engage airspace on Humanitarian Operations and Logistics.

### The use of Airspace and the concept of Airpower

Airspace is the portion of the atmosphere controlled by a country above its territory, including its territorial waters (Rosa, 2014). It is not the same as aerospace, which is the general term for Earth's atmosphere and the outer space in its vicinity. Governments normally control the use of Airspace because it is a matter of national security and sovereignty.

Airpower, on the other hand, is the projection of national power that results from the integration of a nation's different resources and capabilities, in order to use airspace, either as a political and military instrument or as a factor of economic and social development, looking for acquiring and maintaining national goals (Brasil, 2012). Then, airpower can

be considered as the strength of a nation's Air Force.

According to the Basic Doctrine of the Brazilian Air Force (Brasil, 2012), airpower has its own characteristics, which can leverage or limit its use, mainly due to the means it uses and the environment with which it interacts. Such characteristics can be presented as strong points (strength factors) and weak points (weakness factors), which can be, respectively, explored or minimized within the scope of airpower's use.

#### *Airpower's strong points*

Airpower engagement has the following strength factors:

- a) Range: it is related to the potential of an aircraft to achieve objectives at great distances, depending on properties, such as autonomy, in-flight refueling capacity, and external loads, among others;
- b) Flexibility and versatile nature: Air Force Means are essentially flexible and peculiarly versatile. They can quickly switch from one target to another using different tactics, systems, weapons, and assorted sensors, adding the versatility of being able to act at strategic, operational and tactical levels;
- c) Mobility: It results from the ability of specialized personnel, aircrafts, armaments, equipment, and Air Force systems to immediately deploy from one airport to another, operating with equal or greater effectiveness;
- d) Penetration: Characteristic that comes from the capacity that the aircrafts have to enter a terrain, in spite of natural obstacles or any kind of defense structure;
- e) Readiness: It is the consequence of the airpower ability to react immediately to a demand, employing means in the right size, at the precise location and at the right time;
- f) Speed: It stems from the potential of an aircraft to rapidly travel long distances. The speed allows reducing exposure time to other forces, increasing its ability to succeed.

#### *Airpower's weak points*

On the other hand, airpower engagement has the following weakness factors:



- a) High costs: They result from the high value invested in the acquisition, operation and maintenance of an aircraft, armaments, installations, equipment and systems, as well as the time and effort spent in training specialized human resources;
- b) Technology dependency: It results from the fact that the effective use of airpower is very sensitive to technological developments, because it operates aircrafts, equipment, and systems that incorporate cutting-edge technology;
- c) Infrastructure dependency: It originates from the need for specialized installations and equipment for the preparation, launching, support, and reception of aircrafts. This restricts the operation of these artifacts to appropriate airports and special locations, even for a short time;
- d) Fragility: It is a consequence of the intrinsic particularities of aircrafts, equipment, and systems, usually with relatively fragile and easy to destroy components. Damage to their structures can have catastrophic results for operations;
- e) Limited stay: This feature is related to the inability of aircrafts to fly indefinitely, since they need to re-supply, rearrange or change crews, which results in restrictions to continuous activities, thus requiring more aircrafts or repetition of flights to obtain the desired effects;
- f) Load restrictions: It derives from the limitation that aircrafts have to carry personnel, supplies and sensors, which may require the use of multiple vectors and repeated flights to achieve a goal;
- g) Sensitivity to meteorological conditions: This aspect is related to the influence of atmospheric conditions or the lack of sunlight on the ability of aircrafts to accomplish certain missions. Systems and sensors that allow operating in adverse environmental conditions and suitably trained crews decrease the uncertainty of the effects of meteorological conditions in the accomplishment of air operations, but do not eliminate it.

#### *Airpower and Humanitarian Operations*

As discussed before, Humanitarian Operations are very important to help affected people and relief their suffering after a crisis caused by a disaster or catastrophic event. Mainly after natural disasters, humanitarian logistics gain relevance because of the high level of uncertainty and unpredictability that characterizes this set of events.

During the response stage, it is very important to act quickly, in order to save lives. Besides, it is needed to transport people and supplies, to ensure the safe flow of information, and to manage procurement and warehousing, including the high volume of donations and debris.

After presenting airpower characteristics, it seems clear that its strength factors can address humanitarian logistics activities with the needed sense of urgency and speed. However, airpower weaknesses can compromise its use and generate a high cost to humanitarian operations.

Because of this duality, it is important to have access to real data regarding the use of airpower on humanitarian operations, as to evaluate its costs and benefits. In order to contribute with humanitarian operations literature, the next sections present a qualitative case study on the engagement of airpower capabilities during the response stage of a natural disaster in the south of Brazil, at the end of 2008, precisely in the Itajai Valley.

### **3. METHODOLOGICAL ASSUMPTIONS**

As an initial investigation on the use of airpower on humanitarian operations, this study was designed to discover and organize concepts. A qualitative research approach immersed the researcher in the data and encouraged his objectivity and openness to new findings. According to Patton (1985), “the qualitative research is an effort to understand situations in their uniqueness as part of a particular context and its interactions. This understanding demonstrates that this kind of research does not attempt to predict what may happen in the future” (Patton, 1985). Although, it aims to understand the nature of the studied phenomenon and its settings – what it means for participants to be in that setting, what their meanings are, etc. Merriam (1998) explains that the qualitative research assumes that meaning is embedded in people’s experience and that this meaning is mediated through the investigator’s own perceptions.

In such a way, the researcher is the primary instrument for data collection and analysis, which creates the demand for the investigator to physically go to the fieldwork in order to collect data and interview its stakeholders (Merriam, 1998). Thus, the methodological procedures of this research range the selection of a natural disaster, analysis of operational reports and media coverage about the response stage of the selected disaster, interviews with stakeholders, and the analysis of the interview’s transcriptions, as follows.

## Data gathering

Data was gathered through extensive analysis on operational reports made by the BAF, with daily information on air operations during “Missão Santa Catarina” (Mission Santa Catarina). Besides, great media coverage on the disaster and the response stage were also analyzed. Then, three interviews were conducted with the military people involved in the use of airpower during the humanitarian operation. Spradley (1979), Seidman (1998) and Strauss and Corbin (1998) showed that the use of interviews in the qualitative research is a justifiable and legitimate means of gathering information for additional insights and theory development (Seidman, 1998; Spradley, 1979; Strauss and Corbin, 1998). This approach, its execution, and the drivers behind its use are consistent with Merriam’s (1998) arguments that qualitative methods derive from a combination of interpretive sociological traditions and symbolic interactionism.

## Data analysis

The three interviews were transcribed and analyzed with the data gathered from secondary sources (operational reports and media coverage) in search for codes. Data coding followed an inductive approach (Strauss and Corbin, 1998), with the codes emerging from collected data. Each transcript element related to the use of airpower during humanitarian operations was assigned a concatenated code, classifying it along five categories: logistics air supply, victims’ rescue, healthcare provision, food provision and rebuilt access and infrastructure. From this coding scheme, patterns that were validated and qualified across the operations described in the interviews emerged (Strauss and Corbin, 1998).



**Figure 1.** Data analysis categories related to the use of airpower on humanitarian operation

Source: The author.

## The selected natural disaster: flood and waterlogging events in the Itajaí Valley

It was selected a natural disaster of major importance in Brazil that mobilized different organizations during crisis response, including the Brazilian Air Force (BAF). The occurrence of storms and a long uninterrupted rain period in November 2008 caused floods and landslides, destroyed houses, energy distribution lines, and roads, and put the Itajaí Valley region on calamity stage, affecting more than 150.000 people for more than 10 days without access to energy, food or potable water.

The Brazilian government activated an official humanitarian operation called “Missão Santa Catarina”, which combined action between the federal government and local agencies to help affected people and restore basic services to affected communities. The crisis response activities involved the three Brazilian armed forces (Navy, Army and Air Force), different police organizations, civil defense mechanisms, municipalities, and volunteers.

The official mission was conducted between November 24<sup>th</sup>, 2008 and December 18<sup>th</sup>, 2008, with 294 military personnel involved, mainly from the BAF. Their perceptions, previous experience and knowledge were very important to allow a quick learning cycle in order to plan and implement air operations, which involved 14 aircrafts and 540 flown hours.

## 4. MAIN FINDINGS

Through the researcher immersion in the data and the necessary iteration between interview sessions, the fact finding in secondary sources, and data analysis, a set of models was used to describe the benefits regarding the use of airpower on humanitarian operations. Below are brief descriptions of the research findings across the five categories that emerged from the data analysis.

### Logistics Air Supply

During the response stage, airpower capabilities were engaged to predict, provide and maintain all the material and supplies that were necessary to support humanitarian operations. As a wide geographical area was affected by landslides and floods, logistics air supply was very important to transport search and rescue teams to affected areas and give them all the material support to accomplish their mission. In this way, airpower was important to transport people, equipment, and supplies to areas with difficult land access.



In order to keep logistics air supply activities, the BAF made available the use of eight military aircrafts (three C-95 Bandeirante, three C-98 Caravan, one C-105 Amazonas, and one C-130 Hercules), which flew 286 hours to complete 71 air supply missions. During these missions, the aircrafts transported 215 passengers and 460 tons of cargo.

During the interviews, it was possible to identify that the military characteristics of involved aircrafts made possible to transport heavy equipment and a great amount of cargo, which would need more flight hours if different kinds of aircrafts were engaged.

### Victims' Rescue

Six helicopters (three H-1H Bell Huey, two H-34 Super Puma, and one H-60 Blackhawk) were engaged by the BAF to complete 105 search and rescue missions (SAR). These aircrafts have embedded SAR capabilities, as they have a rescue hook and always fly with specialized crew for this type of mission. That is the reason why it was possible to rescue 2.626 victims with 254 flight hours.

Besides, airpower characteristics of readiness, speed and penetration were provided by military helicopters and made possible to rescue a large number of victims, with an average of 25 people per flight. Certainly, this number of people was only possible because of the embedded capabilities brought by specialized crew and aircrafts.

### Healthcare Provision

After being rescued, all victims received medical assistance on a military campaign hospital, structured on adapted tents and barracks, with 43 people, including physicians, nurses and infrastructure personnel. This health assistance structure made possible to conduct 2,921 healthcare treatments, with 64,725 medicine products being distributed. Most importantly, these numbers also involve treatments provided to military crew and volunteers engaged on response activities. However, more than 90% of treatments were given to victims.

All the hospital structure was transported by air to the nearest airport, located at the city of Navegantes-SC, and then transported by trucks to be placed very close to the air operations headquarters.

### Food Provision

A military feeding and subsistence structure, called Remote Feeding Supply Module (MAPRE, from the Portu-

guese), was also engaged. This structure made possible to put in place a logistic scheme where the food was prepared and chilled at the city of Canoas-RS and transported by air to Navegantes-SC. Then, the final preparation of the food was conducted at MAPRE facilities. Eleven people were involved in the food provision mission, including chefs and waiters, and 5,019 meals were served to military personnel and volunteers involved on the crisis' response stage.

### Rebuilt Access and Infrastructure

Airpower capabilities were also important to help activities in order to rebuilt access and infrastructure. The most affected places could not be reached by car because of landslides and floods. In this way, the technicians involved on rebuilding efforts were transported by air and in the last mile the delivery of the needed equipment was made by helicopters, taking advantage of search and rescue missions. It was possible because of airpower flexibility, as the aircraft departed from the air operations headquarters with technicians and equipment, which were delivered on the affected areas, and the helicopters made their way back to headquarters searching and rescuing victims.

## 5. DISCUSSION

During this research, it was possible to identify how airpower characteristics can affect humanitarian operations. At one side, airpower strong points are very relevant during a crisis' response operation, mainly for humanitarian logistics. The penetration characteristic is very important to reach affected areas, which normally would be inaccessible by land right after a natural disaster. Penetration capability, allied to readiness, range and mobility, can help save lives during humanitarian operations. Besides, the characteristics of flexibility and versatile nature are relevant as they enable airpower to engage in different missions at the same time. For example, helicopter crews conducted SAR and air supply logistics missions at the same time.

Range and mobility characteristics were present all the time during crisis response stage. For example, the possibility to transport and build a military campaign hospital at place on a couple of days was extremely important to relief victims suffering. Besides, the possibility to provide meals with excellent quality for staff people was relevant to keep them with high levels of energy and motivation. Table 1 demonstrates the relationship between humanitarian operation needs and airpower strength factors.

**Table 1.** Relationship between humanitarian operation needs and airpower characteristics

| Humanitarian Operation needs | Airpower Characteristics                          |
|------------------------------|---|
| SAR activities               | Readiness, Penetration, Speed, Flexibility        |
| Distribute relief supplies   | Mobility, Range, Readiness, Penetration, Speed    |
| Provide healthcare           | Mobility, Range, Speed, Flexibility               |
| Provide feeding              | Mobility, Range, Speed, Flexibility               |
| Transport staff people       | Readiness, Penetration, Flexibility               |
| Transport equipments         | Readiness, Penetration, Flexibility               |
| Transport donates            | Readiness, Range, Speed, Penetration, Flexibility |
| Transport debris             | Mobility, Flexibility, Range, Readiness           |

Source: The author

On the other hand, airpowers' weak points demonstrate that some limitations are involved to engage airpower capabilities. As the studied crisis was caused by a long period of rain, the helicopters were not available to operate all the time due to meteorological conditions. Besides, SAR activities were set to happen between sunrise and sunset. Another important aspect relates to the high costs of air operations. The analyzed reports did not mention budgetary values; however, it is well known that the flight hour of the involved aircrafts is expensive. In this way, it is not possible to mobilize airpower capabilities without federal and local government support.

Therefore, it is highly recommended that defense security structures, whether public institutions or non-governmental organizations (NGOs), should establish communication mechanisms with local armed forces to quickly engage airpower if necessary.

## 6. FINAL CONSIDERATIONS

This paper followed the objective to present benefits reached with the use of airpower resources during humanitarian operations. It was possible to verify how airpower characteristics influenced the response stage of crisis management during a natural disaster in Brazil, by means of a qualitative case study to collect and analyze data on the engagement of airpower during a real scenario. Primary and secondary data were gathered from operational reports, provided by the Brazilian Air Force, and from the media coverage about flood and waterlogging events in the Itajaí Valley, Santa Catarina State, in the south of Brazil, between

November and December 2008. Besides, three interviews were conducted with people involved at the crisis' response in order to validate and deepen data collection.

It was selected a natural disaster of major importance in Brazil, which mobilized different organizations during crisis response, including the BAF. In November 2008, the occurrence of storms and prolonged rain, without interruption, caused floods and landslides, destroyed houses, energy distribution lines, and roads, and put the Itajaí Valley in a state of calamity, affecting more than 150.000 people for more than 10 days, without access to energy, food or potable water.

The Brazilian government activated an official humanitarian operation called "Missão Santa Catarina", which combined action between the federal government and local agencies to help affected people and restore basic services to affected communities. The crisis response activities involved the three Brazilian armed forces (Navy, Army and Air Force), different police organizations, civil defense mechanisms, municipalities, and volunteers.

The official mission was conducted between November 24<sup>th</sup>, 2008 and December 18<sup>th</sup>, 2008 with 294 military personnel involved, mainly from BAF. Their perceptions, previous experience and knowledge were very important to allow a quick learning cycle in order to plan and implement air operations involving 14 aircrafts and 540 flown hours.

Five core categories were identified to illustrate airpower engagement during humanitarian operations, which are: Logistics Air Supply, Victim's Rescue, Healthcare Provision, Food Provision, and Rebuilding Access and Infrastructure. It was possible to evaluate the impact of airpower engagement on humanitarian operations because of the increase of capabilities. Missions for Logistics Air Supply flew 286 hours to complete 71 air supply missions. During these missions, eight aircrafts transported 215 passengers and 460 tons of cargo. Six helicopters were engaged by BAF to complete 105 SAR missions, which rescued 2,626 victims with 254 flight hours. Healthcare and Food Provision were also conducted by means of transporting and putting in place a Military Campaign Hospital and a Remote Feeding Supply Module. All the structure of both complexes was transported by air to provide 2,921 healthcare treatments and the distribution of 64,725 medicine products during operations. Besides, technicians and equipment were also transported by air to promote the rebuilding access and infrastructure of the affected area.

On the other hand, it was possible to understand that airpower engagement during humanitarian operations involves a large and complex structure, with trained people and highly technological equipment. Thus, the research also demonstrates airpower weakness factors, such as infrastructure

dependency and sensitivity to meteorological conditions. Besides, even though it was not possible to analyze cost values, the high cost to engage airpower capabilities on humanitarian operations was perceived. That is the reason why it is highly recommended that defense security structures, whether public institutions or non-governmental organizations (NGOs), should establish communication mechanisms with local armed forces to quickly engage airpower, if necessary.

Finally, this study is an initial approach to fulfill a gap in the specialized literature about the use of airpower on humanitarian logistics and future research is recommended to understand how airpower was engaged during other natural disasters or even during the response stage of other types of crises.

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**Received:** 12 Jun 2019

**Approved:** 22 Jun 2019

**DOI:** 10.14488/BJOPM.2019.v16.n3.a11

**How to cite:** Silveira dos Santos, R. A. (2019), "The use of Airpower on Humanitarian Operations: a case study in Brazil", *Brazilian Journal of Operations & Production Management*, Vol. 16, No. 3, pp. 490-500, available from: <https://bjopm.emnuvens.com.br/bjopm/article/view/868> (access year month day).